



Lab 01 Worksheet

Getting to Know Your Robot – Let's Get Moving!

Robot Name _____

Team Member Name _____

Team Member name _____

Purpose

In your own words, state the purpose of lab 01 in the following space.

In your own words, what is odometry error?

Inventory

Check to confirm all parts received or list missing parts in the following space and go to ECE parts room to retrieve. ☐

Part 1 – Software Installation

Check to confirm “RobotIntro.ino” downloaded and all libraries installed ☐

Part 2 – Wire the Robot

Motor wiring CONFIRMED ☐

LED wiring CONFIRMED ☐

encoder wiring CONFIRMED ☐

Part 3 – Robot Motion

How does varying the stepTime variable change the robot behavior?

Describe what the following functions do in the following space.

- move1()
- move2()
- move3()
- move4()
- move5()
- move6()

Describe what the following functions do in the following space.

- move()



- moveTo()
- stop()
- run()
- runSpeed()
- runToPosition()
- runToNewPosition()
- runSpeedToPosition()

Part 4 – AccelStepper Library

Review the library documentation and explain what the following functions do.

- Blocking
- Bounce
- ConstantSpeed
- MultipleSteppers
- MultiStepper
- Overshoot
- ProportionalControl
- Quickstop
- Random

Part 5 – Encoders

Left encoder ticks for quarter turn _____

Left encoder ticks for half turn _____

Left encoder ticks for full turn _____

Left encoder ticks for two turns _____

Right encoder ticks for quarter turn _____

Right encoder ticks for half turn _____

Right encoder ticks for full turn _____

Right encoder ticks for two turns _____

1. Are these values consistent for each motor? Why or why not? In other words, is it the same value for subsequent rotations?



2. Are these values consistent between motors? Why or why not? In other words, is it the same amount for a quarter turn forward for the left and right motor?
3. What is the difference in encoder ticks between forward and reverse motion? Do the encoder ticks appear to hold directional information such as subtracting off for reverse or continuing to increment for backward movement? Is it the same number of encoder ticks for a quarter forward as a quarter backward?
4. How could you use this information to correct for odometry error?
5. Compare the accuracy between encoder ticks and steps for a given distance (i.e. 2 feet). How many ticks/step or steps/tick was it off? Over or under? Is it scalable? For example, are the number of encoder ticks for two feet double the number of encoder ticks for one foot?
6. How many inches or feet can it move in a quarter, half, full, and two rotations?
7. Compare the accuracy between encoder ticks and steps for a given distance (i.e. 2 feet). How many ticks/step or steps/tick?
8. Describe how you can use a proportional controller to move the robot a given distance and correct for odometry error. Hint: You will need sensor feedback where the input is steps or distance.

Part 6 – Motion Functions – DEMO DUE NEXT CLASS

1. How can you distinguish the anode and cathode on an LED?
2. Why do we put a resistor in series with an LED?
3. How many steps does it take to move your robot **forward** 2 feet? _____
4. What is the error between the desired distance and the actual distance? _____
5. How many steps does it take to move your robot **backward** 2 feet?

6. Are the forward and reverse steps the same? If not, why do you think that happens?
7. How many steps does it take to **spin** the robot clockwise ninety degrees? _____
8. How many steps does it take to **spin** the robot counterclockwise ninety degrees? _____



9. Are the clockwise and counterclockwise steps consistent? If not, why do you think that happens?
10. How many steps does it take to **pivot** the robot clockwise ninety degrees? _____
11. How many steps does it take to **pivot** the robot counterclockwise ninety degrees? _____
12. Are the clockwise and counterclockwise steps consistent? If not, why do you think that happens?
13. What is the diameter and circumference of the robot wheels? How did you use these in a formula to design the circle or turn function?
14. How many inches or feet can the robot move in a quarter, half, full, and two rotations?
15. How did you calculate the turn angle for the robot? Explain and show formula in memo.

Part 7 – Circle and Figure 8 – DEMO DUE IN ONE WEEK

1. In the following space, describe how you designed the moveCircle() function with the flexibility of adjusting movement based upon the desired diameter.
2. What is the diameter and circumference of the robot wheels? How did you use these in a formula to design the circle or turn function?
3. How did you modify the function to work for the figure eight?

Part 8 – Go To Angle Behavior - DEMO DUE IN ONE WEEK

1. In the following space, describe how you designed the GoToAngle() function with the flexibility of adjusting movement based upon the desired angle.
2. What type of accuracy/error did you have in the go-to-angle behavior?
3. How did you calculate the turn angle for the robot? Explain and show formula in memo

Part 9 – Go To Goal Behavior DEMO DUE IN ONE WEEK

1. In the following space, describe how you designed the GoToGoal() function with the flexibility of adjusting movement based upon the desired x and y position.
2. How did you calculate the move distance given the x and y position? Explain and show formula in memo?



3. What type of accuracy/error did you have in the go-to-goal behavior?
4. What could you do to improve the accuracy of the behaviors?
5. Did your team use the turn then forward approach for go-to-goal or move and turn at the same time? If so, what were the pros and cons of using your approach versus the other one?

Part 10 – Square Path - DEMO DUE IN ONE WEEK

In the following space, describe how you designed the moveSquare() function with the flexibility of adjusting movement based upon the desired diameter.

Conclusions

1. Describe the method, pseudocode, flow chart, or state diagram. Discuss the reality with the theory and software design plan. What was similar? What was different? You can copy over your prelab in your response and compare this to the reality of what you did.
2. What is your robot's name? Write 2 or 3 sentences to describe how your robot's name relates to some historical figure, robot, or theory in robotics. Make sure to use proper citations and referencing.
3. What are some sources of the odometry error?
4. How could you correct for this error?
5. Describe how you can use a proportional controller to move the robot a given distance and correct for odometry error. Hint: You will need sensor feedback where the input is steps or distance.
6. How could you improve the three motions (*moveSquare*, *moveCircle*, *moveFigure8*) functions? Improve the accuracy of the behaviors?
7. What did you learn? What questions do you still have?